PHOTOGRAMMETRY-DERIVED ORTHOIMAGERY AND ELEVATION DATA FOR PILOT POINT, ALASKA, COLLECTED JUNE 1–3, 2021

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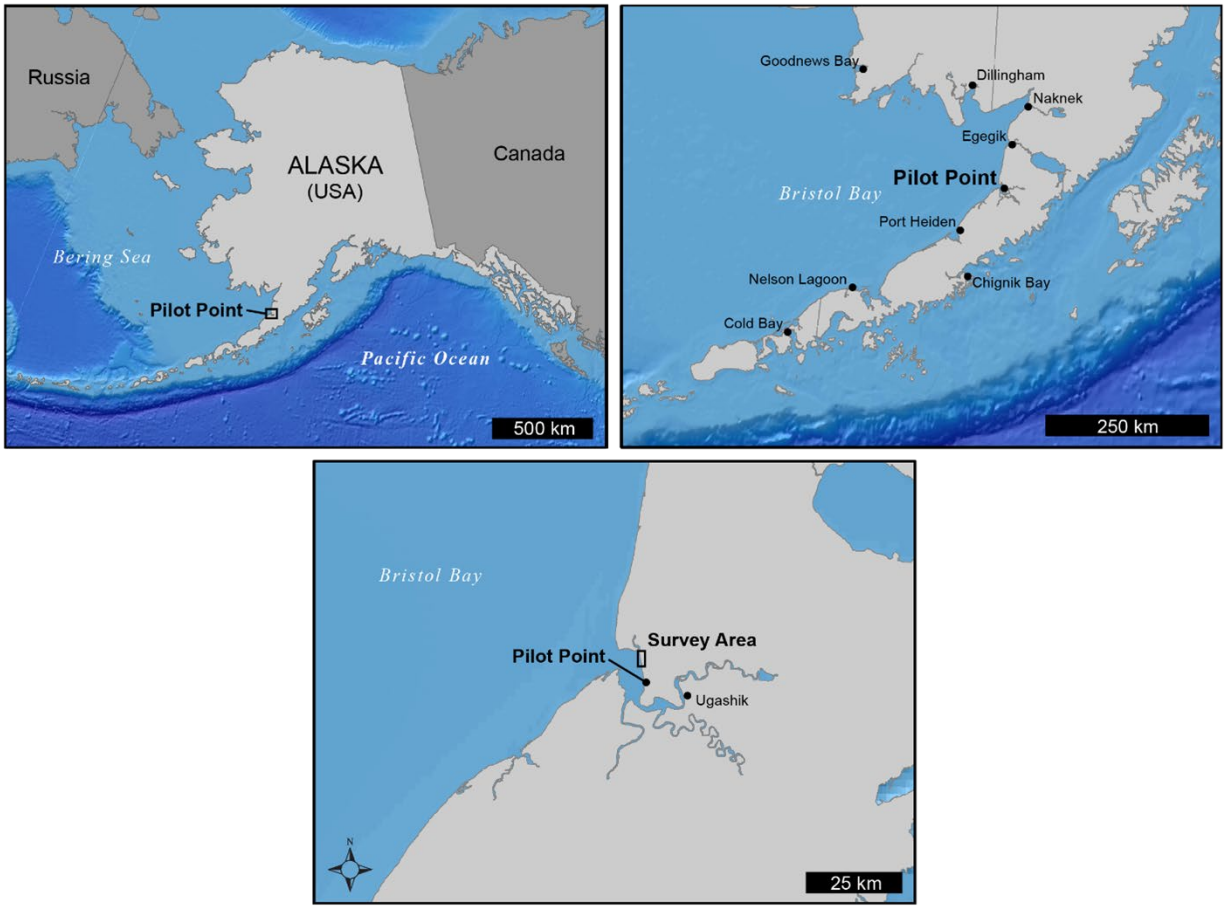
Raw Data File 2022-13



Location map of survey area

This report has not been reviewed for technical content or
for conformity to the editorial standards of DGGS.

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PHOTOGRAMMETRY-DERIVED ORTHOIMAGERY AND ELEVATION DATA FOR PILOT POINT, ALASKA, COLLECTED JUNE 1–3, 2021

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INTRODUCTION

The Arctic Coastal Geoscience Lab (ACGL) collected low-altitude aerial images from an unmanned aerial vehicle (UAV) between June 1 and June 3, 2021, and used Structure-from-Motion (SfM) photogrammetry to produce a digital surface model (DSM) and orthoimagery of Pilot Point (fig. 1). The orthoimage and elevation data were collected to assess coastal hazards and changes. We used Trimble Business Center to process the Global Navigation Satellite System (GNSS) data used for positional control. We used Agisoft Metashape to process photogrammetry data. These products are released as a Raw Data File with an open end-user license. All files can be downloaded from https://doi.org/10.14509/30905 or elevation.alaska.gov.

LIST OF DELIVERABLES

- Orthoimagery
- Digital Surface Model (DSM)

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- Metadata

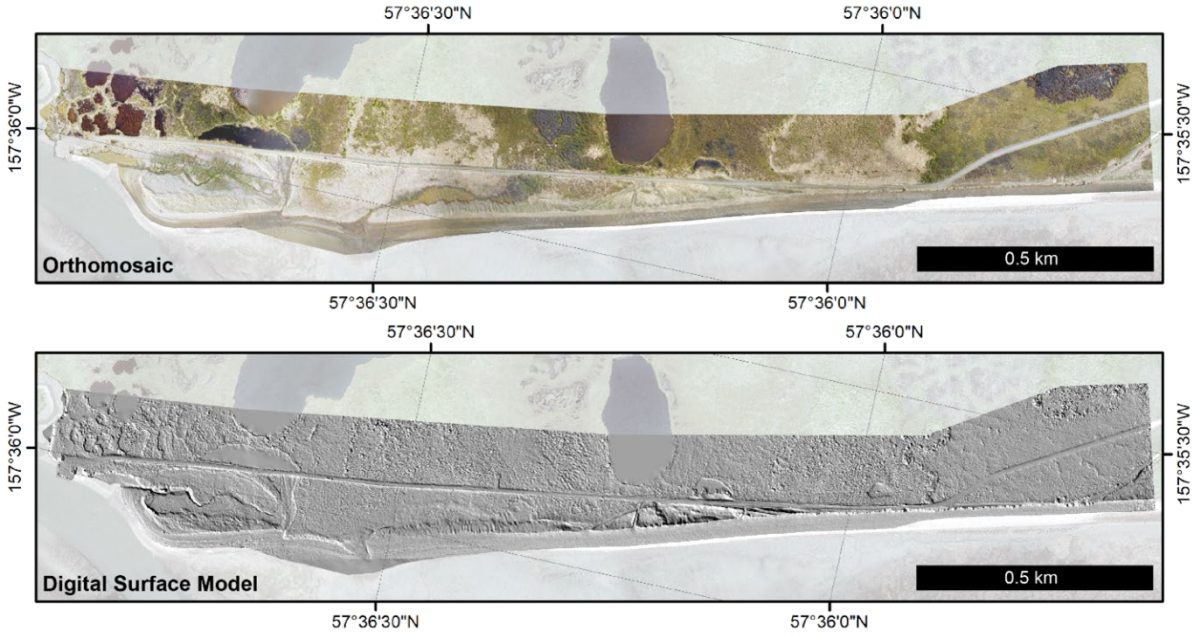

Figure 1. Extent of orthoimage (top) and digital surface model (bottom) for Pilot Point.

MISSION PLAN

Aerial Photogrammetric Survey Details

ACGL used a DJI Phantom 3 Advanced UAV with an FC300S camera model (3.61 mm lens) to collect 12-megapixel JPEG photographs (4000 x 3000 pixels per image). We flew the aerial survey with 80 percent sidelap and 80 percent frontlap, 120 m above the ground at between 7.5 m/s, with nadir orientation stabilized using a 3-axis gimbal. This resulted in 788 images covering 0.6 km^2 with ground sampling distance (GSD) of 0.07 m.

Weather and Photo Conditions

ACGL conducted flights between June 1 and June 3, 2021, from 10:00 AM to 4:00 PM AKDT. The operator returned the UAV four times to change batteries. The weather throughout the survey was favorable with little to no clouds, no rain, and no wind. No abnormalities were observed during the flights.

SURVEY AND PROCESSING REPORT

Ground Survey Details

ACGL set up a GNSS base station using the Trimble R8 receiver sampling at 1 Hz. The base was installed over a temporary benchmark of unknown position. This provided real-time kinematic (RTK) corrections to the UAV and Trimble R2 GNSS receiver (ground rover). The corrected base position was derived using the Online Positioning User Service (found at http://www.ngs.noaa.gov/OPUS/). The R2s' positions were updated using post-processing kinematic (PPK) corrections in Trimble Business Center. ACGL measured 117 photo-identifiable ground control points (GCPs) with the ground rover, 98 of which were utilized for georeferencing during processing. The remaining 19 were reserved for quality control checks.

Photogrammetric Dataset Processing

During the survey, the UAV maintained RTK connection. Within the UAV GNSS receiver settings, the lever arm correction is automatically applied and camera GNSS coordinates are written to the image metadata in WGS84 ellipsoid. Yaw, pitch, and roll information are not written to the image metadata. During processing we update UAV positions using an X, Y, and Z shift from the initial to corrected base position.

ACGL processed the data in Agisoft Metashape Professional software (Version 1.5.5 build 7618). Processing steps included aligning images, identifying GCPs, manually cleaning the sparse point cloud, optimizing the bundle block adjustment (refining camera position and lens distortion parameters), constructing the dense point cloud, building the DSM, and creating the orthomosaic image. During processing, we used 98 GCPs to create the model, leaving 19 GCPs as horizontal and vertical check points.

Orthoimagery

The orthoimage is a three-band (red, green, blue), 16-bit unsigned GeoTIFF file with a GSD of 0.065 m per pixel; the "No Data" value is set to 0.

Digital Surface Model

The DSM represents surface elevations such as the height of vegetation and buildings. Since water bodies can introduce noise, we selectively removed areas manually where inland

water bodies introduced excessive noise. The DSM is a single-band, 32-bit floating point GeoTIFF file with a GSD of 0.13 m; the "No Data" value is set to -32767.

ACCURACY REPORT

Coordinate System and Datum

All data were processed and delivered in NAD83 (2011) UTM Zone 4N and vertical datum NAVD88 (GEOID12B).

Horizontal Accuracy

We quantify the horizontal accuracy of the DSM and orthoimage by comparing the known locations of 19 photo-identifiable check points measured with GNSS against their modeled locations in the photogrammetric products (fig. 2). These are independent checkpoints not used in processing. X and Y errors are calculated as the root-mean-square (RMS) error of offsets. The total horizontal error is the root-sum-square error of X and Y RMS errors, 0.073 m (table 1).

Vertical Accuracy

We assess the vertical accuracy of the DSM using the same check points. The RMS error of Z offsets is 0.083 m (table 1). The total error of the DSM (X, Y, and Z) is 0.111 m.

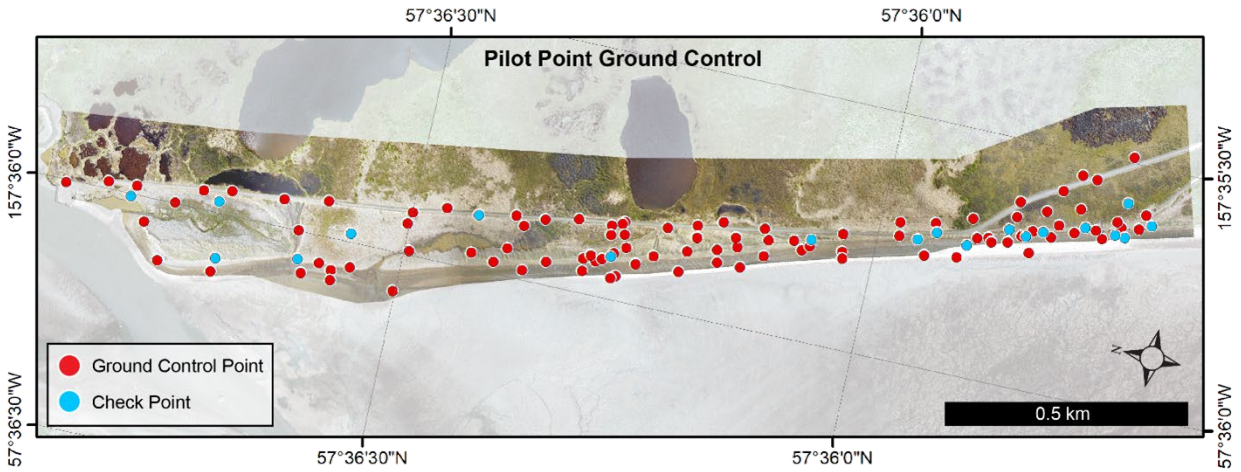

Figure 2. Location of photo-identifiable ground control points (red) and check points (blue).

Data Consistency and Completeness

ACGL visually inspected the orthoimage for data errors such as shifts, seamline mismatches, and water noise overlapping land. There were no significantly erroneous areas that required repair. Visual errors common to these SfM photogrammetry products include discontinuous powerlines, blurriness near high-angle features such as buildings, and distortion at water boundaries. Bright objects, such as metal roofs and white paint, can cause overexposure and lead to spurious elevation points.

ACKNOWLEDGMENTS

We thank the Native Village of Pilot Point for funding supporting the creation of these data products. These data were produced by the University of Alaska Fairbanks Arctic Coastal Geoscience Lab (UAF-AGCL). The DGGS Coastal Hazards Program and UAF-AGCL work collaboratively to collect

baseline data in Alaska communities and to produce raw data file publications for public access and archiving.

Table 1. Check point coordinates and offsets from orthoimagery and DSM.

Check Point	Easting	Northing	Elevation (m)	X Offset (m)	Y Offset (m)	Z Offset (m)
PIP21_GCP_4	583870.616	6385175.890	7.830	0.047	-0.013	0.039
PIP21_GCP_11	583922.366	6384967.198	4.557	0.065	-0.008	0.062
PIP21_GCP_13	583944.827	6384932.636	6.948	-0.025	-0.029	0.003
PIP21_GCP_16	583934.252	6384867.960	3.144	-0.034	0.124	-0.017
PIP21_GCP_21	583979.404	6384755.818	4.076	0.005	0.034	-0.045
PIP21_GCP_22	583985.541	6384792.738	6.528	-0.025	-0.034	-0.025
PIP21_GCP_26	584094.060	6384571.067	6.663	-0.011	-0.009	-0.112
PIP21_GCP_27	584060.471	6384513.742	5.774	-0.009	-0.016	-0.179
PIP21_GCP_29	584024.689	6384561.660	3.415	0.081	-0.036	-0.146
PIP21_GCP_31	584025.090	6384581.691	3.811	0.074	0.022	-0.042
PIP21_GCP_48	584025.990	6384643.358	6.845	-0.055	0.015	-0.044
PIP21_GCP_50	583996.413	6384724.629	6.824	0.058	-0.017	-0.015
PIP21_GCP_84	583760.398	6385840.140	5.459	-0.038	-0.133	0.108
PIP21_GCP_86	583741.642	6385561.679	7.115	-0.041	-0.020	-0.019
PIP21_GCP_106	583662.631	6386356.603	3.872	0.092	-0.052	-0.146
PIP21_GCP_107	583549.464	6386337.655	5.574	-0.003	-0.063	0.069
PIP21_GCP_112	583631.294	6386532.123	4.357	-0.049	0.043	0.067
PIP21_GCP_116	583587.033	6386175.087	4.548	-0.008	-0.054	-0.103
PIP21_GCP_124	583662.709	6386082.268	4.738	0.090	0.029	-0.033
			Mean	0.011	-0.011	-0.030
			Standard Deviation	0.050	0.051	0.078
			Range	0.147	0.257	0.287
			Root Mean Square Error	0.051	0.052	0.083
			Total Error	**0.073**		**0.083**
				(XY)		**(XYZ)**